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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 10/591,093 | 08/29/2006 | Jiro Kondo | 52433/861 | 7884 |

26646 7590 01/20/2011

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| EXAMINER | |
|---|---|
| COHEN, STEFANIE J | |
| ART UNIT | PAPER NUMBER |
| 1732 | |
| MAIL DATE | DELIVERY MODE |
| 01/20/2011 | PAPER |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/591,093 | KONDO ET AL. | |
| | Examiner | Art Unit | |
| | STEFANIE COHEN | 1732 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *11 November 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/11/2010 has been entered.

### *Claim Rejections - 35 USC § 103*

Claims 1-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mellstrom et al (WO8902415).

Mellstrom teaches a method for the purification of silicon wherein the method is preferably carried out such that silicon is melted and heated to 1500-1600oC in a melting furnace, whereupon the slag forming agent is added. The particle size of the slag forming agent is not critical, but less fumes and less dust are obtained if coarser materials are used. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention that the slag forming agents would be in powder form because Mellstrom teaches a suitable particle size for the slag forming agents may be added in one or several runs.

The composition of the slag suitably is 0.1-50% by weight of solid chlorine compounds, 0-50% by weight of at least one compound selected from the group

consisting of oxides, carbonates and hydroxides of alkali and or alkaline earth metals and 0-80% by weight of silica.

After the addition of the slag forming agents and heating for the desired period of time, the melt in the furnace consists of 2 phases, a lower silicon phase and an upper slag phase. Thus, the slag is a top slag. To be able to separate the silicon from the slag, it may be necessary to allow the slag to cool somewhat to cause it to set.

Further, the slag forming agents constitute the extraction phase ie some impurities pass from the silicon phase into the slag phase.

*Further, Mellstrom teaches solid chlorine compounds are used as the active slag-forming component. As solid chlorine compounds, chlorides of alkali and/or alkaline earth metals may be used, such as sodium, potassium or lithium chloride, or calcium, magnesium, barium or strontium chloride. Other conceivable solid chlorine compounds are hypo- chlorites, chlorates or perchlorates of alkali and/or alkaline earth metals.*

Because Mellstrom teaches that other than chlorides, other solid chlorine compounds such as hypochlorites, chlorates or perchlorates can be used, any solid added is not a chloride that generates chloride containing gas, as claimed. The present claim only excludes a solid that is a chloride, not all solid chlorine compounds. Nor does the present specification provide a positive recitation of excluding other chlorine compounds.

Regarding claim 2, Mellstrom teaches after the addition of the slag forming agents and heating for the desired period of time, the melt in the furnace consists of 2

phases, a lower silicon phase and an upper slag phase. Thus, the slag is a top slag. To be able to separate the silicon from the slag, it may be necessary to allow the slag to cool somewhat to cause it to set.

Regarding claims 3 and 6, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the interval time of adding the additives to discharging to achieve maximum purification of the silicon material.

Regarding claims 4-5 and 7, it would have been obvious to one of ordinary skill in the art at the time of the invention that the order of the addition of the slag materials would have no impact on the final silicon product as long as all the components are well mixed.

Regarding claims 8 and 10, it would have been obvious to one of ordinary skill in the art at the time of the invention to discharge already formed slag as many times as needed to obtain additional space for further treatment of the raw silicon having a boron concentration.

Regarding claim 9, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the interval time of adding the additives to discharging the formed slag to achieve maximum purification of the silicon material.

Regarding claim 11, it would have been obvious to one of ordinary skill in the art at the time of the invention to discharge already formed slag as many times as needed to obtain additional space for further treatment of the raw silicon having a boron concentration.

Further, Mellstrom teaches producers of solar cell silicon have especially wished for a boron reduction to 1-5 ppmw in the starting material, and this has not been possible with the prior art techniques.

Regarding clam 12, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the quantity of silica and sodium carbonate added to the molten silicon to obtain the purist form of silicon.

Regarding claim 13, Mellstrom, example 1, teaches the slag forming agents consisted of 250 kg CaO which can be considered the one compound selected from the group consisting of oxides, carbonates and hydroxides of alkali and or alkaline earth metals and 875 kg of SiO2.

Therefore, this would result in a mol ratio of the moles of silicon in SiO2 to moles of the alkali element in one or both of the carbonate of alkali metal and the hydrate of a carbonate of an alkali metal to be around 3.

Regarding claims 14 and 15, Mellstrom teaches the composition of the slag suitably is .1-50% by weight of solid chlorine compounds, 0-50% by weight of at least one compound selected from the group consisting of oxides, carbonates and hydroxides of

alkali and or alkaline earth metals and 0-80% by weight of silica.

### *Response to Arguments*

Applicant's arguments have been fully considered but they are not persuasive.

In contrast to the presently claimed method, Mellstrom discloses slag forming components containing solid chlorine compounds. See Mellstrom, page 2, lines 8 to 15, and the Abstract. As will be understood by one of ordinary skill in the art, the chloride compounds disclosed by Mellstr6m, e.g., chlorides of alkali and/or alkaline earth metals, are of the type that will produce a chloride containing gas when added to molten silicon.

Examiner respectfully traverses. The claimed method teaches the exclusion of a chloride that generates a chloride containing gas when added to molten salt.

Although Mellstrom teaches the addition of chloride compounds, Mellstrom further teaches *other conceivable solid chlorine compounds are hypo- chlorites, chlorates or perchlorates of alkali and/or alkaline earth metals.*

Examiner interprets these solid compounds as that are solids that are chlorides.

Applicant further argues in addition, the presently claimed method provides unexpected results when compared to Mellstrom. In particular, the examples provided in the present specification demonstrate that the presently claimed method provides a significantly more purified silicon than does the process disclosed by Mellstrom. For example, the boron, B, content of the silicon produced in Example 2 of the present specification is 0.06 ppm. See, the present specification, page 24, lines 32 to 34. In

contrast, the lowest boron content for "purified" silicon disclosed in the examples of Mellstrom is 5 ppm. See Mellstrom, page 4, lines 14 and 15.

Claim 1 does not claim a specific boron amount in the final product. As shown in the specification examples, the final boron amount depends on the initial amount present in the silicon and the number of times the refining is repeated.

Further, example 2 further refines a low Si that has an initial B content of .29 mass ppm. The final B mass ppm depends on the initial amount of the B in the Si. Further, the refining is done 3 times to achieve a low B content of .06 mass ppm. Therefore, applicant cannot make a direct comparison with the examples as taught in Mellstrom because in Mellstrom the refining only takes place once.

As shown in example 1 of the specification, after the first refining step B drops from 12 mass ppm to 1.7 mass ppm.
As shown in Mellstrom, after a first refining step B drops from 13 or 17 ppm to 6 or 5 ppm.

In addition, the presently claimed method provides unexpected results when compared to Mellstr6m. In particular, the examples provided in the present specification demonstrate that the presently claimed method provides a significantly more purified silicon than does the process disclosed by Mellstr6m. For example, the boron, B, content of the silicon produced in Example 2 of the present specification is 0.06 ppm. See, the present specification, page 24, lines 32 to 34. In contrast, the lowest boron

content for "purified" silicon disclosed in the examples of Mellstr6m is 5 ppm. See Mellstr6m, page 4, lines 14 and 15.

As previously stated, example 2 of the instant specification further refines a low Si that has an initial B content of .29 mass ppm.

Applicant cannot make a direct comparison with the examples as taught in Mellstrom because in Mellstrom the refining only takes place once.

As shown in example 1 of the specification, after the first refining step B drops from 12 mass ppm to 1.7 mass ppm.

As shown in Mellstrom, after a first refining step B drops from 13 or 17 ppm to 6 or 5 ppm.

Therefore, a further explanation is needed on how applicant arrives at unexpected results.

Further, applicant has not shown that the solid components as taught by Mellstrom cannot achieve even lower mass ppm B amount than in its examples by either using certain amounts of the solids combined with multiple refining steps using the solids as taught by the applicant in the examples of the instant specification.

## ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to STEFANIE COHEN whose telephone number is

(571)270-5836. The examiner can normally be reached on Monday through Thursday 9:3am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Melvin Curtis Mayes can be reached on 5712721234. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Stefanie Cohen 1/4/2011

SC

January 18, 2011

/Melvin Curtis Mayes/
Supervisory Patent Examiner, Art Unit 1732